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RECENT TRENDS IN U.S. CROP YIELDS AND THEIR IMPLICATIONS FOR CROP PRICES

by

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During the mid to late 1970s an assumption of declining growth in the yields of major field crops underpinned most discussions concerning U.S. agriculture (for example, see Everson, Waggoner, and Ruttan; Ruttan; and Wittwer). However, recent surpluses of U.S. farm commodities suggest that this assumption should be reexamined. Therefore, the following discussion examines recent trends in yield per acre of major U.S. field crops. These trends are placed in a post-World War II perspective. Also, their implications for U.S. crop prices are examined.

Recent Trends in U.S. Crop Yields and a Comparison with Post-World War II Trends

Compound annual growth rates between consecutive five-year average yields of major U.S. field crops are presented in Table 1. The crops included are wheat, rice, corn, sorghum, oats, barley, peanuts, soybeans, sunflowers, cotton, hay, and tobacco. Growth rates begin with those between the 1948-52 and 1953-57 average yields and end with those between the 1973-77 and 1978-82 average yields. Table 2 contains the five-year average yields used to compute the growth rates. Five-year averages were used to smooth year-to-year fluctuations, thereby revealing longer-term trends.[1]

For all crops except peanuts, the compound annual growth rate between 1973-77 and 1978-82 average yields was higher than the growth rate between

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[1]Selection of different dates on which to center the five-year averages (two and seven instead of zero and five for example) would change the absolute values for yields and growth rates but not their general trends.

Table 1: Compound Annual Growth Rate between Five-Year Average Yields of Major Field Crops, United States, 1948-1952 to 1978-1982

CROP	YEARS 1948-1952/ to 1953-1957	1953-1957/ to 1958-1962	1958-1962/ to 1963-1967	1963-1967/ to 1968-1972	1968-1972/ to 1973-1977	1973-1977/ to 1978-1982
	- - - percent - - -					
Food Grains						
Wheat(a)	3.04	4.43	1.45	3.86	-0.78	2.41
Rice(b)	4.74	3.53	4.73	1.34	0.26	0.62
Feed Grains						
Corn(a)	1.94	5.69	4.34	3.29	0.47	4.21
Sorghum(a)	1.85	12.90	4.12	2.35	-1.16	2.19
Oats(a)	0.34	3.94	1.72	2.50	-1.33	2.03
Barley(a)	1.61	1.81	4.38	2.59	-0.92	4.14
Oilseeds						
Peanuts(b)	2.84	4.13	6.32	4.14	4.59	-0.06
Soybeans(a)	-0.66	3.09	0.17	2.36	0.07	1.91
Sunflowers(b)	----c	----c	----c	-1.18	2.23	3.20
Other						
Cotton(b)	5.87	3.85	1.87	-1.28	0.59	0.78
Hay(d)	1.67	2.76	1.24	2.28	0.58	2.17
Tobacco(b)	2.46	3.54	3.16	0.37	-0.15	0.22

(a) Yield per acre measured in bushels.
(b) Yield per acre measured in pounds.
(c) Not applicable since sunflower yields were not collected until 1962.
(d) Yield per acre measured in tons.

SOURCE: Computed from data in USDA, Agricultural Statistics, 1967, 1972, 1981; and USDA, Crop Production Annual Summary for 1982.

Table 2: Five-Year Average Yields of Major Field Crops, United States, 1948-1952 to 1978-1982

CROP	YEARS 1948-1952	1953-1957	1958-1962	1963-1967	1968-1972	1973-1977	1978-1982
Food Grains							
Wheat(a)	16.7	19.4	24.1	25.9	31.3	30.1	33.9
Rice(b)	2281.8	2876.0	3421.2	4236.0	4528.6	4469.4	4609.2
Feed Grains							
Corn(a)	39.6	43.6	57.5	71.1	83.6	85.6	105.2
Sorghum(a)	19.8	21.7	39.8	48.7	54.7	51.6	57.5
Oats(a)	34.6	35.2	42.7	46.5	52.6	49.2	54.4
Barley(a)	26.5	28.7	31.4	38.9	44.2	42.2	51.7
Oilseeds							
Peanuts(b)	838.8	964.8	1180.6	1603.8	1963.0	2457.4	2450.6
Soybeans(a)	21.4	20.7	24.3	24.3	27.3	27.4	30.1
Sunflowers(b)	----[c]	----[c]	----[c]	974.4	919.4	1023.6	1197.4
Other							
Cotton(b)	282.3	375.8	453.6	497.6	466.6	480.0	499.2
Hay(d)	1.4	1.5	1.7	1.8	2.1	2.1	2.4
Tobacco(b)	1267.8	1431.0	1703.6	1990.2	2027.0	2012.4	2034.2

(a) Yield per acre measured in bushels.
(b) Yield per acre measured in pounds.
(c) Sunflower yields were not collected until 1962.
(d) Yield per acre measured in tons.

SOURCE: USDA, Agricultural Statistics 1967, 1972, 1981
USDA, Crop Production Annual Summary for 1982

1968-72 and 1973-77 average yields. However, the amount of increase varied substantially. Whereas compound annual growth rates for wheat and the feed grains increased at least three percentage points, rates for rice, cotton, and tobacco increased only marginally. Growth rates for the remaining crops, soybeans, sunflowers, and hay, increased at least one percentage point but less than two percentage points. It therefore appears that yield growth rates increased substantially during the late 1970s but only for crops associated with midwestern and plain states.

In absolute terms, the highest yield growth rates during the most recent period were those of corn and barley. They were 4.21 and 4.14 percent respectively. In contrast, yields of rice, peanuts, cotton, and tobacco increased less than one percent annually with peanuts the smallest at -0.06 percent. In fact, growth rates for rice, cotton, and tobacco have been less than one percent since mid-1960, a rate substantially below those of the other crops examined.

Despite the recent increase in yield growth rates for wheat, feed grains, soybeans, and hay, their rates generally remain below the mid-1950 to mid-1960 growth rates. In particular, they remain below those for the 1953-57 to 1958-62 period. During this period, yields of these crops (except barley) increased at least three percent annually. The high rates reflected large increases in the use of genetically improved seed and fertilizer, particularly nitrogen.

To summarize the preceding, during the late 1970s yield growth rates for crops associated with the midwestern and plain states increased substantially while those for crops associated with the south increased only marginally. However, yield growth rates for all crops remained below those of the late 1950s and 1960s.

Impact of Recent Crop Yield Growth Rates on Prices

The upturn in yield growth rates for wheat, feed grains, and soybeans during the late 1970s along with the decline in their export growth rates resulted in sharp price declines during the early 1980s. But what are the future implications of current yield growth rates? To examine this question, it was rephrased as: by how much must exports increase to fully utilize the increase in supply resulting from the current yield growth rates given a stable land input and a compound annual growth rate in domestic demand equal to that between the 1970 and 1971 and the 1981 and 1982 marketing years. The two assumptions reflect the observations that expansion in the land base will likely occur at a relatively slow rate in the future and that domestic demand will grow at a relatively steady rate with a reasonable short-run projection being a simple extension of the recent past.

To parameterize the answer to the above question, a second case in which yields increase at their 1968-72 to 1973-77 rates was examined. Table 3 contains the results for both cases. Data availability limited the analysis to wheat, rice, corn, sorghum, barley, oats, cotton, and soybeans.

If the 1968-72 to 1973-77 yield growth rates are assumed, exports would not have to increase over their current levels to utilize production except for sorghum, oats, and cotton. In fact, exports would have to decline or else prices would have to increase. The need for increased exports of sorghum, oats, and cotton reflects their declining domestic consumption.

In contrast, should yields continue to increase at their 1973-77 to 1978-82 rates, exports of all crops except rice would have to increase at an annual rate greater than three percent. Otherwise, prices would be presurred lower. The price outlook would be particularly bleak for feed grains, with corn having the smallest export growth rate, 10.41 percent, and oats having

Table 3. Export Growth Rate Needed to Utilize Production under Two Different Assumptions Concerning Growth Rates of Yields, Selected Crops, U.S., 1981-82

Crop[a]	Export Share of Disappearance[b]	Growth Rate in Domestic Consumption[c]	Export Growth Rate[d]	
			Case A	Case B
		- - - percent - - -		
Food Grains				
Wheat	66	0.56	-1.47	3.36
Rice	55	5.08	-3.68	-3.03
Feed Grains				
Corn	28	1.80	-2.95	10.41
Sorghum	37	-4.79	5.02	14.07
Barley	16	-0.77	-1.71	29.92
Oats	1	-4.38	300.62	636.62
Other				
Cotton	53	-3.73	4.42	4.78
Soybeans	54[e]	3.63[e]	-1.67	4.45

[a]Lack of data excluded peanuts, sunflowers, hay, and tobacco from the analyses.

[b]Share of total disappearance which are exports. Based on actual 1981 disappearance and projected 1982 disappearance.

[c]Compound annual growth rate between averages of domestic disappearance for 1970 and 1971 marketing years and 1981 and 1982 marketing years.

[d]Calculated assuming a stable land base, the stated export share, and the stated growth rate in domestic consumption. Also assumed for Case A a yield growth rate equal to that for the 1967-72 to 1973-77 period (Table 1) and for Case B a yield growth rate equal to that for the 1973-77 to 1978-82 period (Table 1).

[e]Soybean export disappearance includes the smaller of either oil or meal exports in bean equivalents.

Sources: Data in Table 1.
USDA, Agricultural Statistics 1981.
USDA, ERS, Agricultural Outlook, April 1983.

the largest, 636.62 percent. The relatively high export growth rates for feed grains reflect their relatively high yield growth rates and their small export share of total disappearance.

Assuming the 1973-77 to 1978-82 yield growth rates, wheat exports would have to grow at approximately 3.5 percent annually, soybean and cotton exports at approximately 4.5 percent, and rice exports at -3.03 percent. The negative growth rate for rice reflects its small annual yield increase and its large domestic consumption growth rate. For wheat, soybeans, and cotton, the above rates compare with compound annual growth rates of 4.9, 13.3, and 1.1 percent respectively between the 1951 and 1952 and the 1981 and 1982 marketing years. These latter rates are one measure of long-term export growth rates. Therefore, it would appear that if yield growth rates remain at their current level, rice and beans have the greatest upward price potential.

Conclusions

Yield growth rates increased substantially during the late 1970s for those crops associated with midwestern and plain states but not for those associated with southern states. The increased growth rates in feed grain yields would have pressured feed grain and probably other crop prices lower even if export growth rates had not slowed. Furthermore, continuation of these yield growth rates suggests that government price support programs will be a permanent feature of the 1980s even if exports resume their upward trend of the post-World War II period.

BIBLIOGRAPHY

Evenson, Robert E., Paul E. Waggoner, and Vernon W. Rutton, "Economic Benefits from Research: An Example from Agriculture," Science, Vol. 205, September 14, 1979, pages 1101-1107.

Ruttan, Vernon W., "Inflation and Productivity," American Journal of Agricultural Economics, Vol. 61, December 1979, pages 896-902.

U.S. Department of Agriculture, Agricultural Statistics: 1967, 1972, and 1981, U.S. Government Printing Office, Washington: 1967, 1972, and 1981.

U.S. Department of Agriculture, Statistical Reporting Service, Crop Reporting Board, Crop Production: 1982 Annual Summary--Acreage, Yield, and Production, CrPr 2-1 (83), January 13, 1983.

U.S. Department of Agriculture, Economic Research Service, Agricultural Outlook, AO-86, April 1983.

Wittwer, Sylvan H., "Food Production Prospects: Technology and Resource Options," The Politics of Food: Producing and Distributing the World's Food Supply, edited by D. Gale Johnson, The Chicago Council on Foreign Relations, 1980, pages 60-99.